

Part 7 - Radiocarbon Dates

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The radiocarbon analysis and interpretation is presented in this section. There were several contexts (Lots 110, 124, 126, 127, 128 and 130) representing Op.CG phases (Phases 5a, 3a, 3, 2 and 1) from which we were able to obtain AMS dates. All samples studied were of carbonized grain; approximately 30 grains, split into 3 sub-samples of 10 were analyzed for each phasing group. There are 3 per sample so dates are weighted averaged (Long and Rippeteau 1974) and are presented here as reduced to 2 standard deviations. The AMS analyses were conducted at the Center for Accelerator Mass Spectrometry, at the Lawrence Livermore National Laboratory by Thomas Guilderson.

Sample number and context	Operation CG Phase	Tell Leilan Period	Chronological Period
1. L02 CG lot 110 no. 1 2. L02 CG lot 110 no. 2 3. L02 CG lot 110 no. 3	Phase 5a	Terminal Period IIa	Transitional Presargonic/ Akkadian
4. L02 CG lot 124 no. 1 5. L02 CG lot 124 no. 2 6. L02 CG lot 124 no. 3	Phase 3a	Period IIa	Late Presargonic
7. L02 CG lot 126 no. 1 8. L02 CG lot 126 no. 2 9. L02 CG lot 126 no. 3	Phase 3	Period IIa	Late Presargonic
10. L02 CG lot 127 no. 1 11. L02 CG lot 127 no. 2 12. L02 CG lot 127 no. 3	Phase 3	Period IIa	Late Presargonic
13. L02 CG lot 128 no. 1 14. L02 CG lot 128 no. 2 15. L02 CG lot 128 no. 3	Phase 2	Period IIIId	Terminal Ninevite 5
16. L02 CG lot 130 no. 1 17. L02 CG lot 130 no. 2 18. L02 CG lot 130 no. 3	Phase 1	Period IIIId	Late Ninevite 5

The calibration of the radiocarbon dates used Oxcal v.3.5¹. The excellent stratigraphic control at Op.CG suggested that a Bayesian statistical analysis of the calibrated dates to resolve the “start,” “end,” and span of phases could be conducted along with the presentation of the raw ¹⁴C data. These statistical analyses increase the resolution of the probability of the calibrated dates by eliminating the portions of the calibrated ranges that are stratigraphically impossible.

We have presented the information graphically in the following subsections, showing the high-resolution starting and ending points for each phase as well as their spans. In the subsection entitled ‘The City Gate Radiocarbon Sequence’, the complete sequence of phasing as determined from the

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radiocarbon samples has been listed. In this graph, the starting and ending ranges is indicated, as well as the individual radiocarbon calibrations for each separate sample (corresponding to the raw data given in the CAMS table below). The beginning and endings of the phases are labelled as 'Boundary', followed by the phasing name. For each of the separate calibrations listed in this summary graph, there are two separate ranges. The Bayesian statistical analysis is indicated by the solid black range. The unmodified calibrated range for each date is also given in this graph, indicated by a thin black line. In a final subsection, the interpretation of these findings are given and their relevance to Op.CG, and the site of Tell Leilan, and the region are briefly summarised.

CENTER FOR ACCELERATOR MASS SPECTROMETRY

Lawrence Livermore National Laboratory

¹⁴C results

Submitter:	Weiss/Guilderson	DATE:	February 26, 2003			
CAMS #	Sample Name	fraction Modern	±	±	¹⁴ C age	±
94319	L02 CG lot 110 no1	0.6101	0.0021	2.1	3970	30
94320	L02 CG lot 110 no2	0.6069	0.0021	2.1	4010	30
94321	L02 CG lot 110 no3	0.6124	0.0022	2.2	3940	30
94322	L02 CG lot 124 no1	0.6045	0.0022	2.2	4045	30
94323	L02 CG lot 124 no2	0.6012	0.0024	2.4	4090	35
94324	L02 CG lot 124 no3	0.6025	0.0021	2.1	4070	30
94325	L02 CG lot 126 no1	0.6014	0.0021	2.1	4085	30
94326	L02 CG lot 126 no2	0.6057	0.0021	2.1	4030	30
94327	L02 CG lot 126 no3	0.6057	0.0021	2.1	4025	30
94328	L02 CG lot 127 no1	0.6046	0.0021	2.1	4040	30
94329	L02 CG lot 127 no2	0.6046	0.0021	2.1	4045	30
94330	L02 CG lot 127 no3	0.6015	0.0021	2.1	4085	30
94331	L02 CG lot 128 no1	0.6024	0.0023	2.3	4070	35
94332	L02 CG lot 128 no2	0.6028	0.0021	2.1	4065	30
94333	L02 CG lot 128 no3	0.6046	0.0021	2.1	4040	30
94334	L02 CG lot 130 no1	0.6045	0.0023	2.3	4045	30
94335	L02 CG lot 130 no2	0.5971	0.0021	2.1	4145	30
94336	L02 CG lot 130 no3	0.6027	0.0023	2.3	4065	35

1) Individual samples were chemically pretreated using a sequence of acid-base-acid soaks at 90°C. Samples were combusted and the resulting CO₂ cryogenically purified, and reduced to graphite in the presence of iron catalyst. AMS-¹⁴C results are reported in accordance with Stuiver and Polach (1977) and include a background subtraction and δ¹³C correction.

2) The quoted age is in radiocarbon years using the Libby half life of 5568 years and following the conventions of Stuiver and Polach (Stuiver and Polach (1977)).

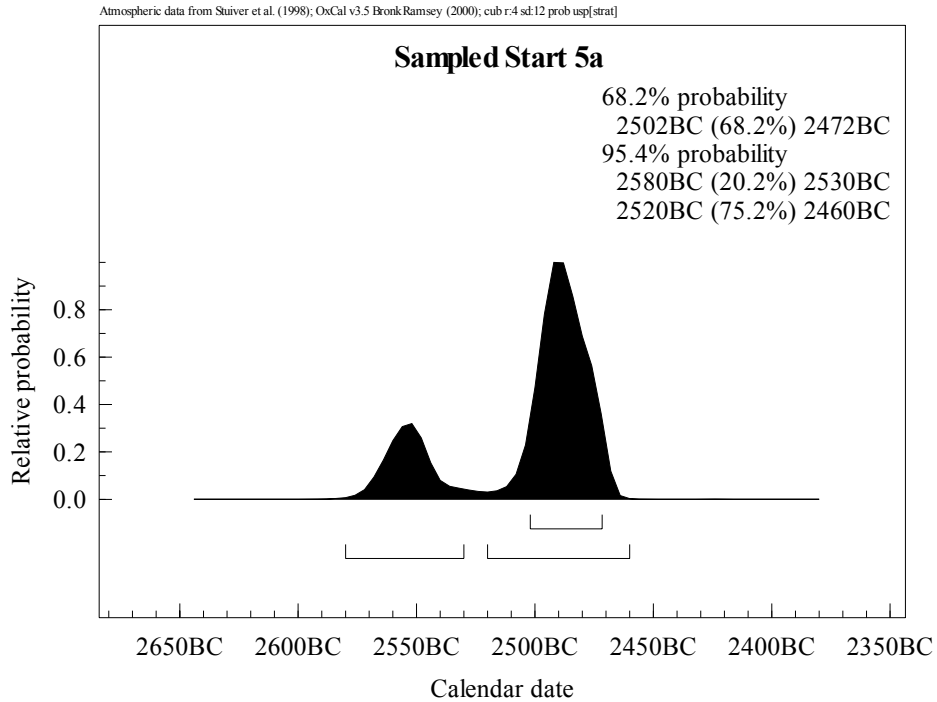
3) Radiocarbon concentration is given as fraction Modern, and conventional radiocarbon age.

4) Sample preparation backgrounds have been subtracted, based on measurements of samples of ¹⁴C-free coal.

Phase 5a

Three samples from Lot 110, a deposit rich in burnt seeds, were used for radiocarbon analysis. Lot 110 is part of Op.CG Phase 5a, or terminal Leilan Period IIa. Significantly, Lot 110 overlies Wall C, indicating that the architectural sequence had been broken prior to the seed layer's deposition (similar to other deposits at Leilan: see Acropolis storerooms from Leilan Period IIa in Weiss *et al.* 2002, fig.10). The dates from Lot 110 are therefore important in dating the end of the presargonic period at Leilan and the beginning of the Akkadian imperial domination at the site.

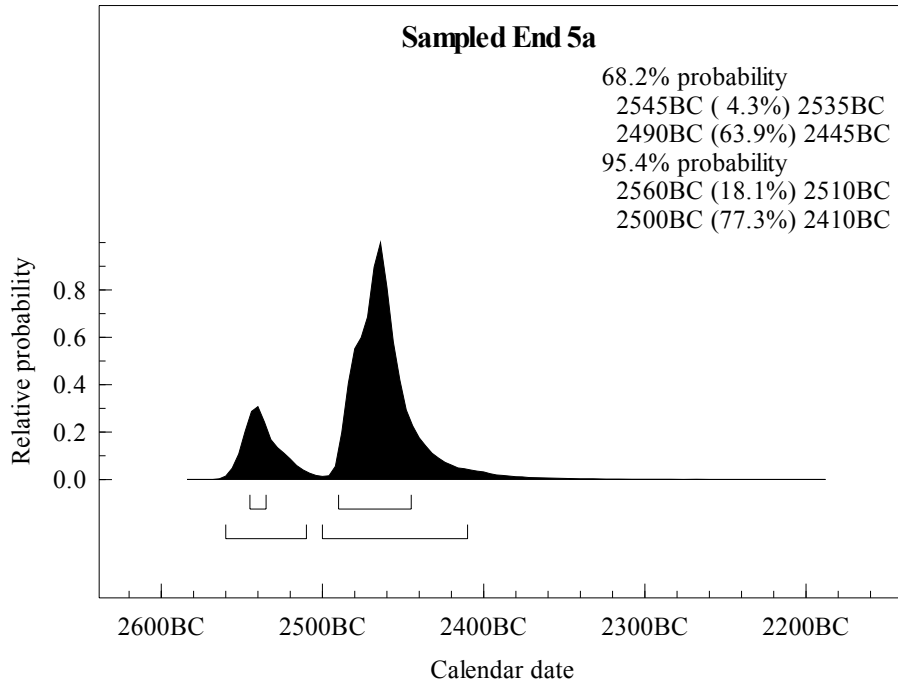
Beginning of Phase 5a



End of Phase 5a

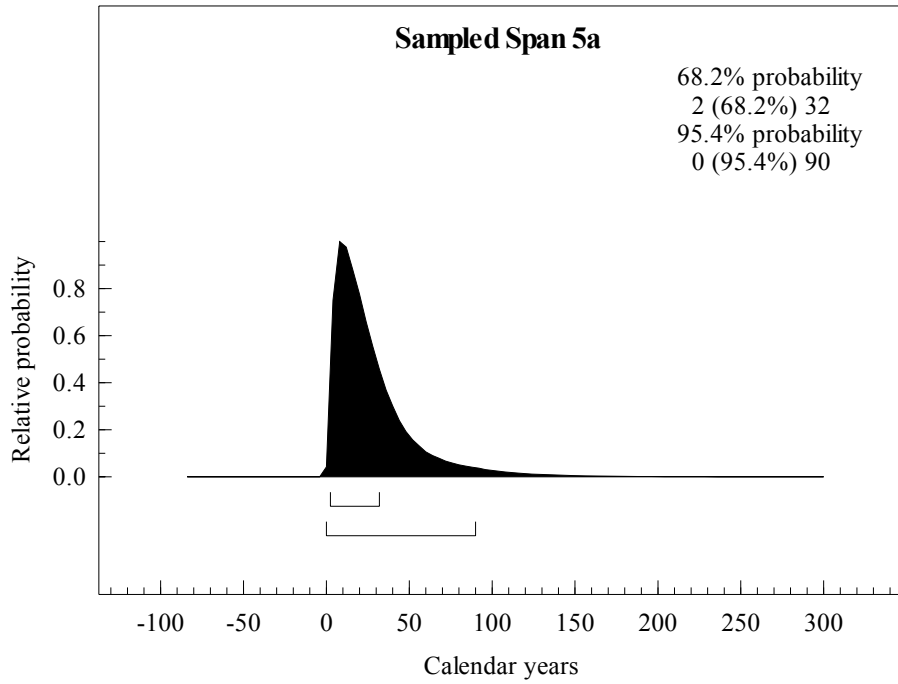
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Atmospheric data from Stuiver et al. (1998); OxCal v3.5 Bronk/Ramsey (2000); cub r:4 sd:12 prob usp[stat]



Calculated Span of Phase 5a

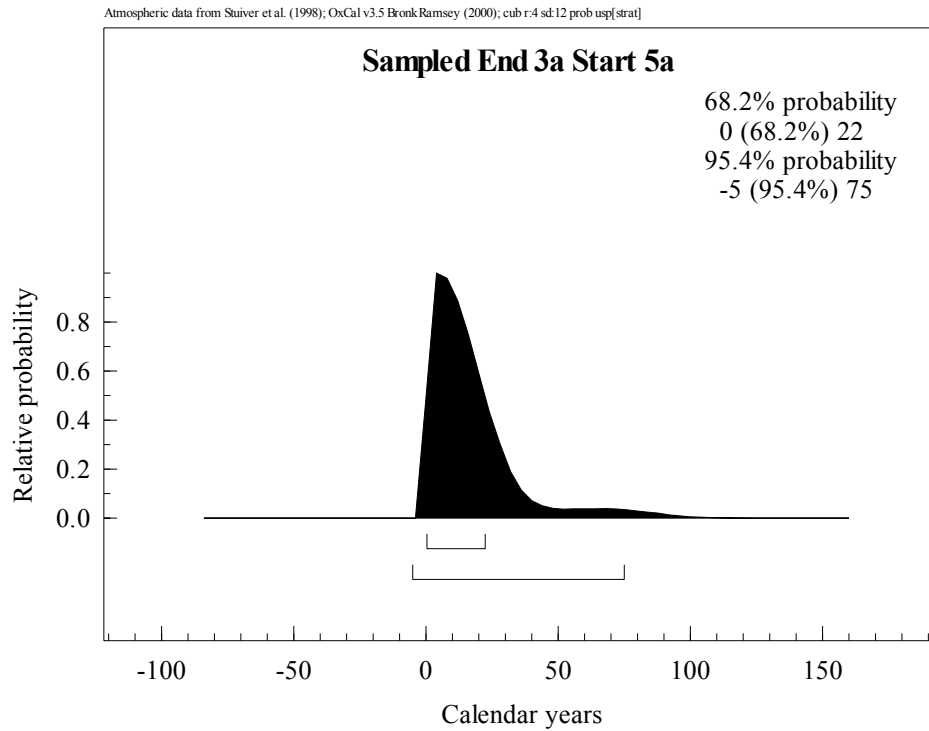
Atmospheric data from Stuiver et al. (1998); OxCal v3.5 Bronk/Ramsey (2000); cub r:4 sd:12 prob usp[stat]



Phases 4 and 5

Based on radiocarbon dates from phases 5a and 3a, it has been possible to determine the probable span of time allowed for phases 4 and 5. While these are indirect chronological designations, they have been derived through statistical calculations of the probable length of interval between the radiocarbon spans for phases 3a and 5a. The following graph shows the probable time span for phases 4 and 5, which indicates a probable maximum of *c.* 75 years for both phases.

Calculated Span of Phases 4 and 5 - Based on Interval

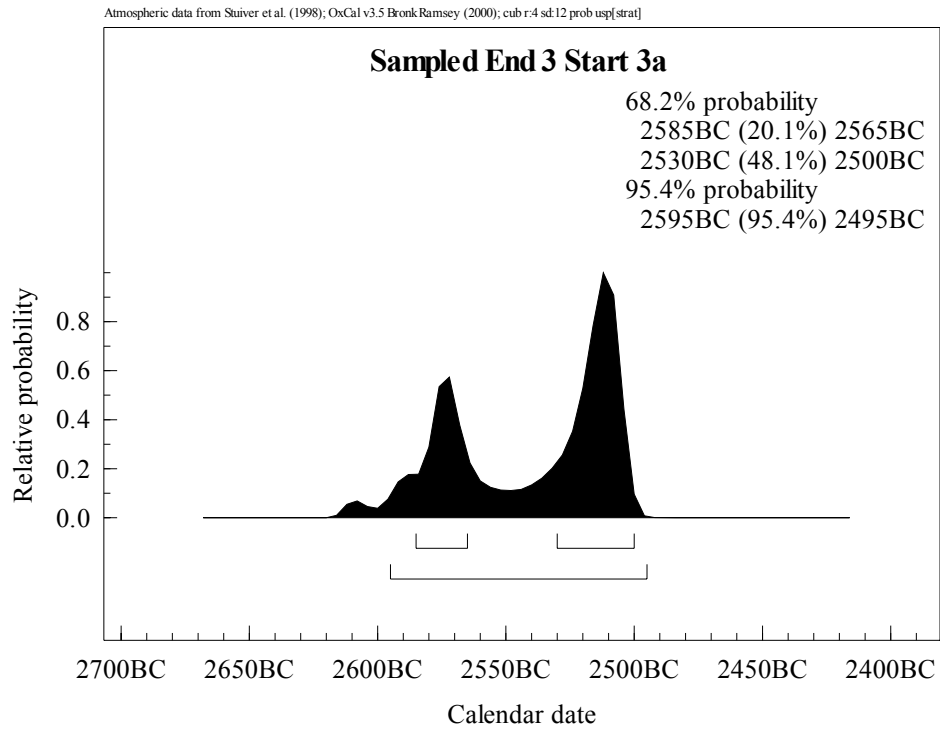


Phase 3a

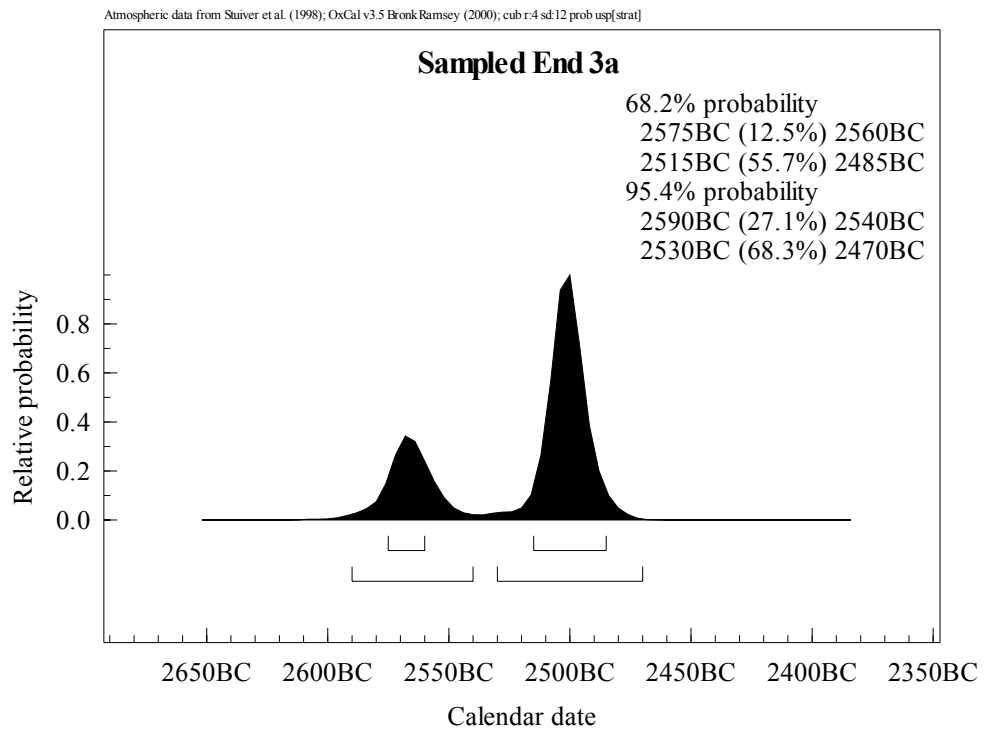
Three samples from Lot 124, a floor associated with the phase 3a tanour (lot 125), were radiocarbon dated giving us an estimate of the dating of this phase. The radiocarbon dates from 3a allow us to accurately determine the beginning and end of this phase, as well as its span.

Beginning of Phase 3a

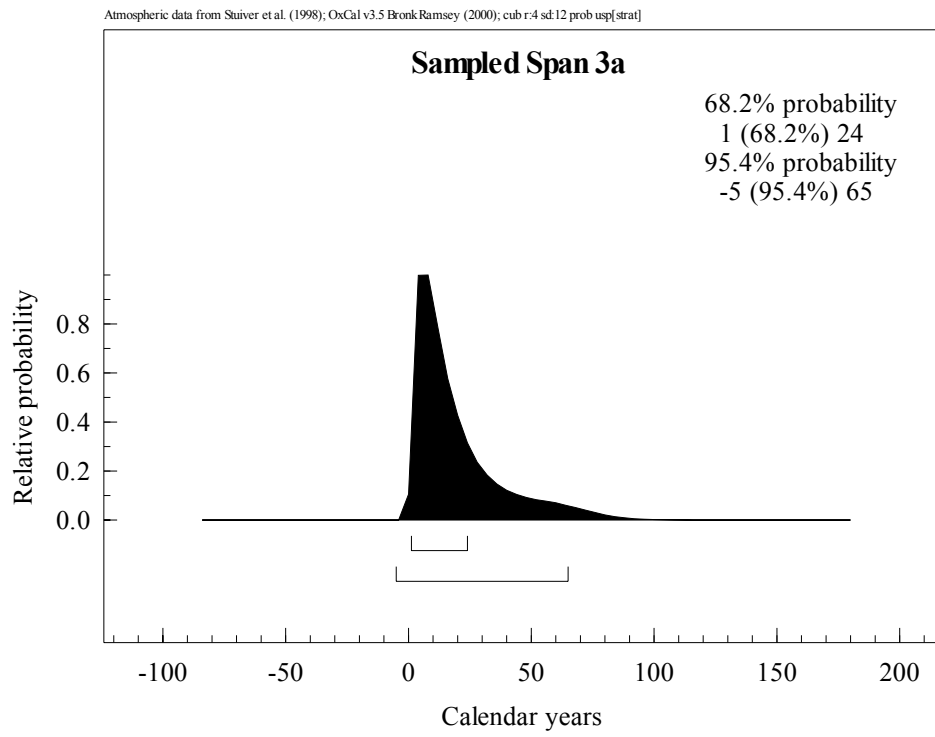
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End of Phase 3a



Calculated Span of Phase 3a

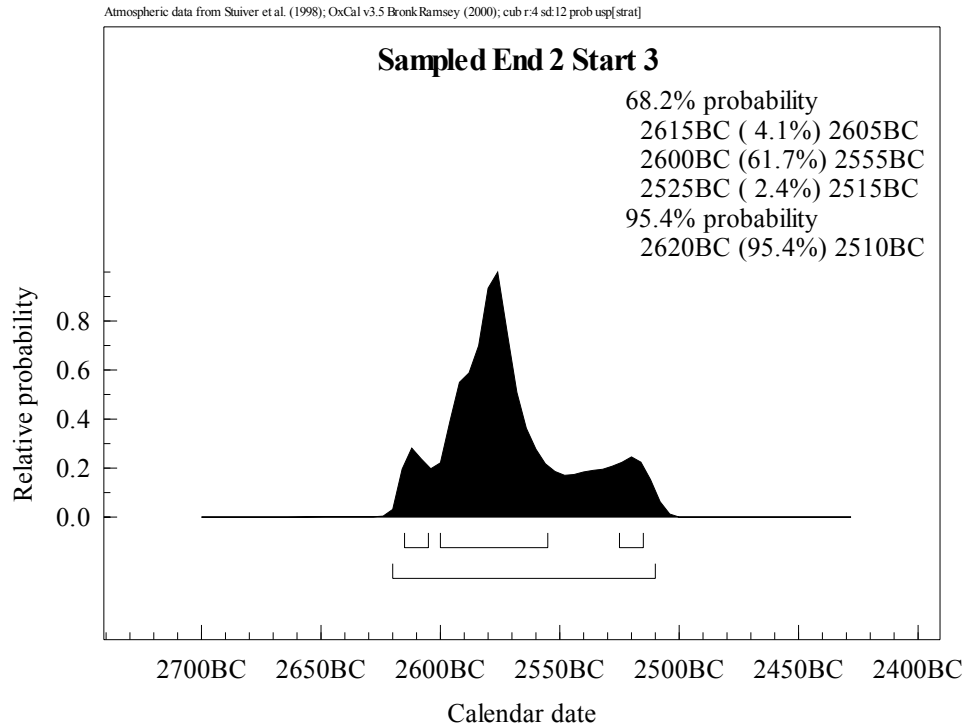


Phase 3

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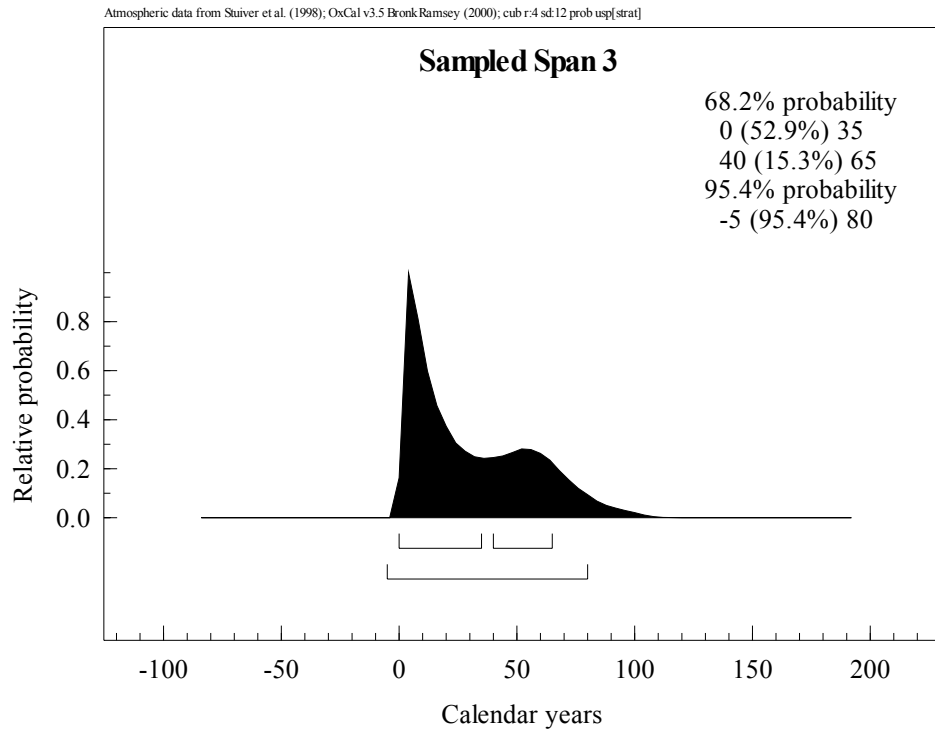
A total of 6 samples were taken from Phase 3 contexts. Three samples from Lot 126 and three from Lot 127 were analyzed to provide a very precise range of dates for this phase. Because we have 6 single-entity samples from 2 secure contexts, this phase can give us an extremely high resolution date for this period (*i.e.* the beginning of Leilan Period IIa). Taken in conjunction with the dates from Phases 2 and 3a, the dating of the cultural sequence signifying the end of the Nivevite 5 period can be precisely determined.

Beginning of Phase 3



Calculated Span of Phase 3

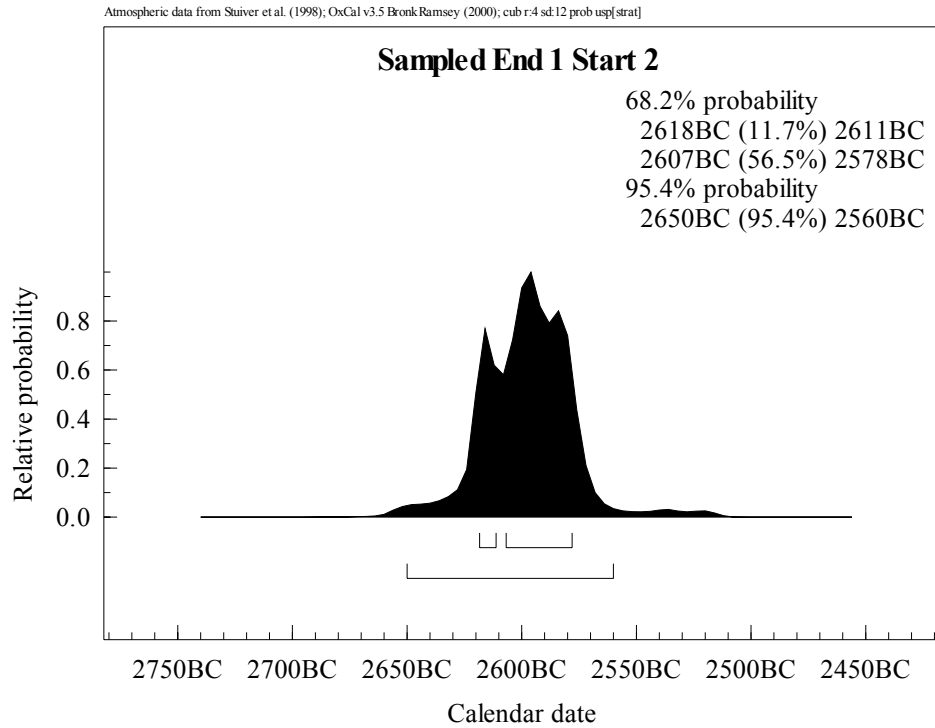
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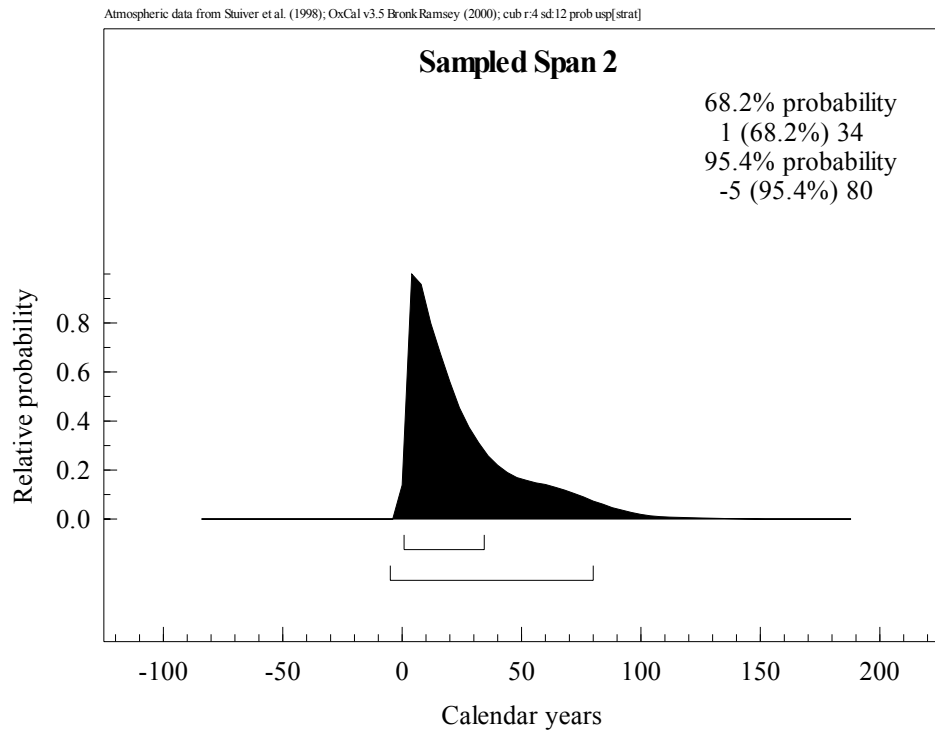
Phase 2

The three samples from Lot 128 provide us with both a high resolution date for the terminal Ninevite 5 material cultural sequence at Tell Leilan and a *terminus ad quem* for the construction of the fortification wall (Wall A).

Beginning of Phase 2



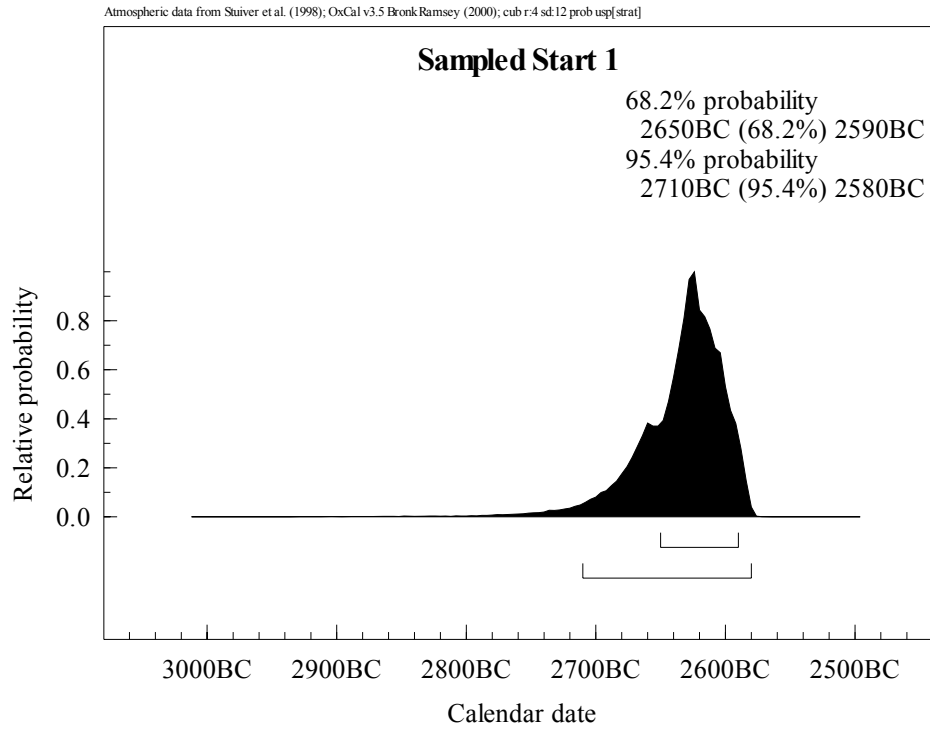
Calculated Span of Phase 2



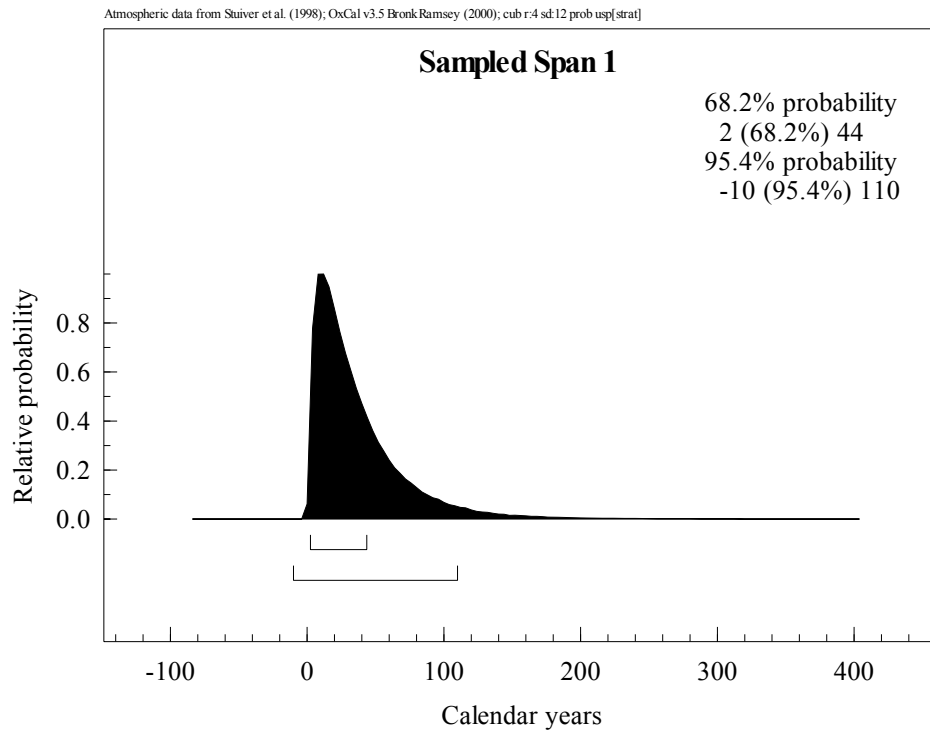
Phase 1

Three samples from Lot 130 provide us with dates for the earliest contexts recovered at the city gate. The dates suggest a relatively short period of time between Phases 1 and 2. Because Phase 1 is an unfortified Ninevite 5 stage, this short time span suggests a rapid expansion of the settlement and a subsequent rapid construction of the fortification system at Tell Leilan.

Beginning of Phase 1



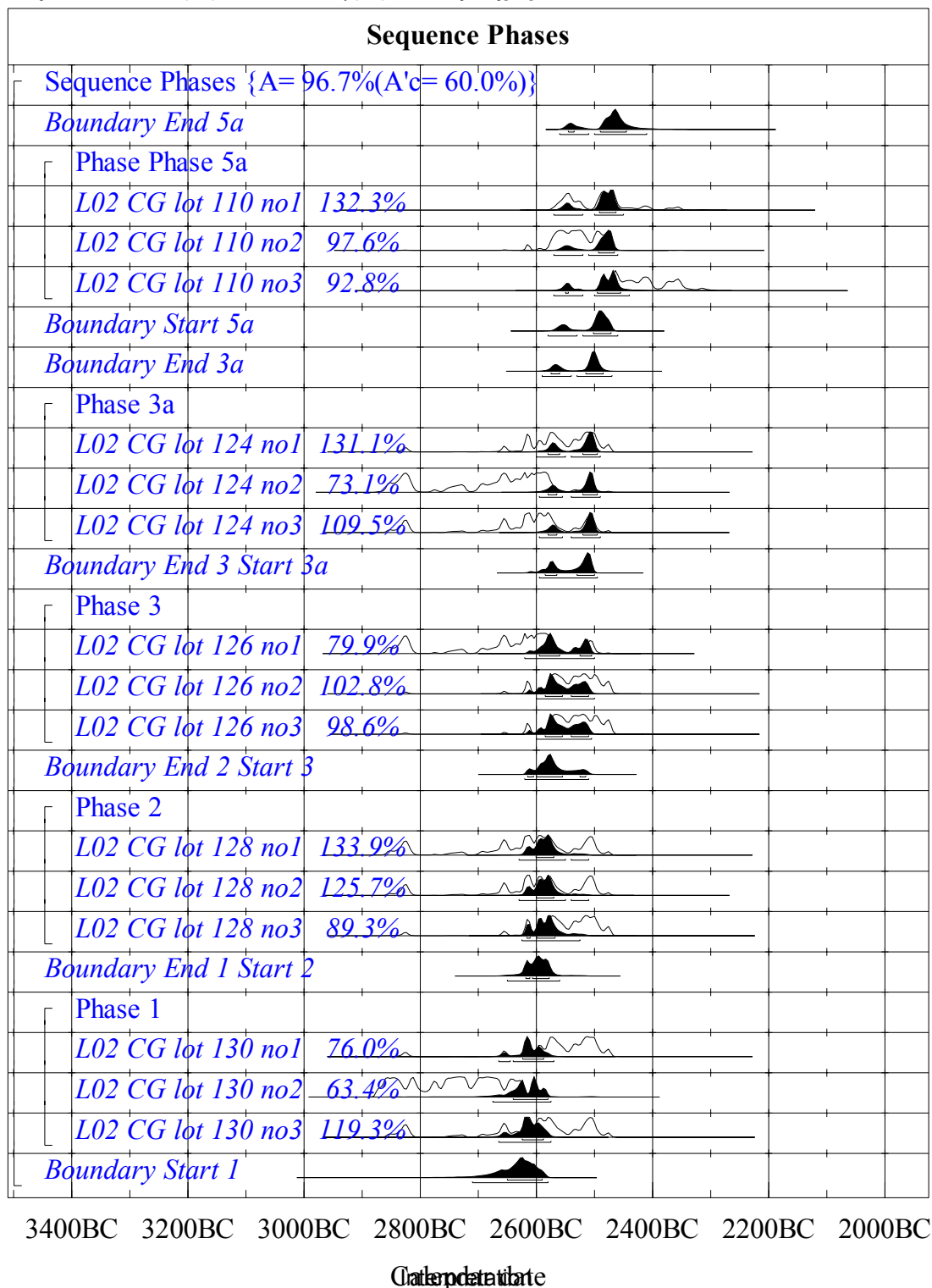
Calculated Span of Phase 1



The City Gate Radiocarbon Sequence

The statistical analysis can also be viewed as a sequence, as in the following graph. This represents the calibrated ranges of each phase, with Phase 5a being at the top and Phase 1 at the bottom. In this way, the approximately 150-year time-span for the Presargonic City Gate sequence can clearly be seen. The 'Bayesian' range is indicated by the solid black range, and the 'standard' calibrated range is indicated by the outlined range. The beginnings and endings of each phase are indicated by 'Boundary' followed by the phase name.

Atmospheric data from Stuiver et al. (1998); OxCal v3.5 Bronk Ramsey (2000); cub.r:4 sd:12 prob usp[strat]



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1974

Antiquity 39, pp.205-215.

Stuiver, M. and Polach, H.A., 'Discussion: Reporting of ¹⁴C Data,' *Radiocarbon* 19, no.3, pp.355-363.
1977

Stuiver, M., Reimer, P.J. and Braziunas, T.F., 'High-precision radiocarbon age calibration for
1998 terrestrial and marine samples,' *Radiocarbon* 40, pp.1041-1083.
1998

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2002 Ristvet, L., Rova, E., and Wetterstrom, W., 'Revising the contours of
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